

Technical Description

MICROSENS MSP 1000 Platform xWDM system



Introduction

Especially in times of continuous data volume growth the ability to network together is a key factor for greater productivity and cost-efficiency. With the scalable MSP 1000 xWDM system platform from MICROSENS telecommunications providers, ISPs, computer centre operators and companies with extensive networks receive a future-proof basis for their steadily growing broadband requirements. Failsafe performance and redundancy are just as important factors as long-term financial sustainability within IT cost planning.

The MICROSENS Optical Transport Platform with its modular setup, enables the structure and capacities of fiber optic lines to be expanded to match the actual requirement. Wavelength division multiplexing allows parallel transmission of several light frequencies on one fiber pair. Each light frequency provides a transmission rate of 2 Mbps up to 16 Gbps. This allows the capacity of fiber optic lines to be increased many times over. Individual services are transmitted separated from one another on non-overlapping frequencies. This allows companies and operators to keep broadband requirements and investments in balance, but they always remain flexible in terms of additional capacities. Should higher requirements for transmission performance arise, the system can be expanded stepwise up to capacities of several hundred Gbps without having to lease additional fiber optic lines.

The Optical Transport Platform from MICROSENS is designed for dependable transmission of high volumes of data at an optimum cost-per-bit ratio. The system achieves the favourable ratio between transmission capacity and overall costs through a combination of complementary technologies, which contribute to a significant reduction in operating and capital costs.

MICROSENS fiber optic solutions – intelligent, reliable, powerful!

Features

As a result of its conceptual structure, the MICROSENS MSP 1000 platform offers a cost-efficient entry into the world of optical transport networks. Through the use of protocol transparent MICROSENS xWDM technology, the useful capacities of backbone connections can be adapted flexibly and quickly to suit the given requirements.

Especially the use of CWDM technology guarantees customers optimum scalability while at the same time ensuring low procurement costs. Expansion of the existing CWDM equipment to become a high performance DWDM system can be implemented with the MICROSENS platform without restrictions even during ongoing operation. Maintaining the existing CWDM infrastructure allows long-term investment protection.

Using CWDM technology up to 16 independent high speed services can be transmitted over a single mode fiber. The individual channels are transparent for the transmitted data, various service protocols with data rates of 2 Mbps to 16 Gbps can be transmitted, e.g. Fast Ethernet, ESCON, ATM OC-12/OC-48, 1/2/4/8/10/16G Fibre Channel, SDH STM-1/4/16 or also Gigabit or 10G Ethernet.

The capacities of existing CWDM systems can be considerable expanded with the use of DWDM technology. A DWDM system offers up to 40 channels on a single mode fiber optic line and, using amplifiers, can bridge extremely long distances up to 500 km. The bandwidth of the individual channels can be expanded up to 16 Gbps with the MSP 1000 series.

Highlights:

- CWDM: up to 16 different services on a fiber optic connection (according to the ITU-T G.694.2 grid standard with 20 nm channel spacing)
- DWDM: up to 40 different services on a fiber optic connection (according to the ITU-T G.694.1 grid standard)
- Hybrid CWDM/DWDM: up to 53 different services on a single fiber optic link
- Compact design, 19" chassis with 4U height and 11 application modules respectively 1U height with 3 module slots – with a maximal mounting depth of 11" for use in swivel frames
- Broad management portfolio, simple to display and apply using SNMP and web based management. Smooth integration in third-party SNMP management platforms is ensured.

1. MSP 1000 - Basic components

1.1. Chassis

1.1.1. MSP 1400 Chassis (MS42550xM)



The 4U chassis MS42550xM is designed as an enterprise chassis and is suitable for setting up both small and larger scale networks.

It excels by virtue of its compactness. Up to 11 slots can be equipped with application modules (hot swappable). All modular

functional plug-in modules and all connectors are accessible from the front panel. The low installation depth also allows mounting in 19" frames under mechanically constrained conditions. The optimal front-to-back air circulation ensures systematic removal of heat and protects the overall system.

The three speed monitored fan modules, included in the chassis, are connected to the alarm system. A redundant power supply in AC, DC or also in mixed voltage operation offers scope for diverse application scenarios. Unused slots are protected with the appropriate blind covers. The format of the slots is oriented towards the Euro card format. The chassis is DIN EN60950-1:2006 and DIN EN55022:2006 Class A certified.

The MS42550xM delivery package includes:

- 4U chassis optional for 230 VAC (MS425500M), 48 VDC (MS425501M) or mixed AC/DC (MS425502M) operation
- Power entry module for primary supply voltage
- Two power slots to accommodate power supply modules
- Three fan modules (speed monitored via the management system)

1.1.2. MSP 1100 Chassis (MS425504M-48)



The 1U chassis MS425504M is used mainly for xWDM applications with compact infrastructures. The chassis has three Euro card

module slots and is fully compatible to the 1 slot modules of the MSP 1000 family. To manage active modules in operation, the use of a management agent (NMx) is mandatory.

The chassis includes four speed monitored fans which are connected to the management system. For the power supply there are two redundant 48 V DC power inputs. Unused slots are protected by blind covers. The format of the slots is oriented towards the Euro card format. The low installation depth allows the mounting into 19" racks with limited space.

1.1.3. MSP 1100 Chassis Passive (MS425505M)



Inside the MSP 1000 family the passive 1U chassis MS425505M is used for mounting passive cards such as Mux/DeMux modules.

The dimensions are similar to the active 1U chassis and it has also three module slots in Euro card format. It is compatible to all 1 slot wide passive cards. Unused slots are protected by blind covers. The low installation depth allows the mounting into 19" racks with limited space.

1.2. Power Supply Modules PA2/PD2 (MS42551x)

These power supply modules are specially designed for use within the MS42550xM chassis. The powerful AC (MS425510 – PA2) and DC (MS425511 – PD2) modules with high efficiency and wide-range input have a 250 W power rating and are connected to the alarm system of the chassis. The user on site can be informed of a possible failure by means of an alarm LED. Power supply is achieved via the power entry module which is delivered with the MSP 1400 chassis.

Which power supply modules are needed in detail, depends on the chosen chassis version:

- AC (MS425500M) 2x 230 VAC (PA2)
- DC (MS425501M) 2x 48 VDC (PD2)
- Mix (MS425502M) 1x 230 VAC (PA2) and 1x 48 VDC (PD2)

1.3. Management Modules

1.3.1. NM3 (MS425523M) and NM3+ (MS425524M)



NM3 and NM3+ are the next generation of management modules for the MICROSENS MSP 1000 Platform. They replace the previous management modules NM1 and NM2.

The increasing requirements of the market regarding network access security and protection against manipulation in optical networks have been the crucial factor for this development.

Priority was put on the implementation of comprehensive security features. Thus the new modules support secure protocols like SNMP V3, SSH or HTTPS and central user authentication via RADIUS and TACACS+. To protect against manipulations the firmware updates are encrypted and signed.





The NM3 Management Module takes up one system slot and provides a 4 Port Gigabit Ethernet switch (2x SFP Slots with 100/1000X, 2x 10/100/1000T RJ-45). The NM3+ requires two slots and offers a total of six Gigabit Ethernet ports (2x SFP Slots with 100/1000X, 4x 10/100/1000T RJ-45), one USB expansion port and four potential-free digital alarm contacts (2x relay output, 2x optocoupler input). Both modules are equipped with a serial RS-232 terminal port for standard RJ-45 console cable.

Features:

- Web Manager (HTTP/HTTPS)
- Command Line Interface via Telnet/SSH/Console, incl. standard commands (ping, traceroute, etc.)
- SNMPv1/v2c/v3
- Central management platform (NMP Standard / NMP Professional / NMP Server)
- IPv4/IPv6 Dual Stack
- Powerful microScript language for the automation of routine processes by means of CLI scripts
- Firmware-, script- and/or configuration files can be loaded, stored and executed directly in the switch (via FTP, SFTP, TFTP)
- Incremental firmware updates
- Network Time Protocol (NTP)

As NM3 and NM3+ management modules are equipped with two SFP ports, several MSP 1000 Platform chassis may be cascaded via optical channels to create a failure tolerant ring structure. If one node fails, the network connectivity is re-established in less than 50 milli-seconds, so all other nodes stay accessible. The ring functionality is fully compatible with the MICROSENS industry switches of the Profi Line, Profi Line+ and Profi Line Modular series.

The hardware of the new Management modules is designed today for future functions, which are easy to activate by means of firmware upgrades. As an established, stable operating system, Linux offers a solid foundation for an intelligent, open and long-term reliable platform.

Thanks to the interchangeable microSD memory card the system status of the management module (configuration, scripts, firmware, optional MAC address) can be completely transferred to a new device, e.g. in case of service. Herewith potential incompatibilities due to different device versions are avoided. The memory card is protected against removal during operation.

The deployment of a fault tolerant journaling file system ensures high reliability and stability. The security option allows for the system to be encrypted.

The user model provides for the definition of individual access rights for each user – in analogy to the SNMP V3 "View-based" SNMPv3 rights model. This access view model may also be applied to SNMP V1 or V2c access, practically creating SNMP V3 like access protection, but without its complexness.

The integrated central RADIUS server allows a central user authentication (according to IEEE 802.1X) based on username/password, certificate or MAC address.

During login users can be centrally authenticated by the TACACS+ server or per RADIUS. Furthermore the access may be restricted via Access Control Lists (ACL).

For a detailed list of the available software features see the associated document "Firmware Feature List Generation 6 Ethernet Switches" in its latest version.

2. Passive Optical Multiplexers

Optical filters and passive multiplexers bundle or split light of different wavelengths and form the heart of every WDM system. The extremely flexible MICROSENS concept allows their use in all MSP 1000 chassis. The WDM filters can be connected together to optimally adapt to the customer requirement.

The mutually matched CWDM and DWDM filters guarantee seamless upgrading, while minimising start-up costs for smaller systems. A highly flexible system can be set up in combination with universal transponders. Usually the extremely compact MICROSENS optical filters combine multiplexers and de-multiplexers in a common module. In most cases the very high packing density allows the realisation of the complete function within just one slot width. All connections are configured with conventional LC-plug connector technology.

MICROSENS offers a diverse range of CWDM and DWDM multiplexer modules, whereof the most important versions will be introduced in the following chapters. More details and further versions are described in the relevant data sheets.

2.1. CWDM Multiplexer for up to 16 Channels FC8 / FC8A / FC8X

The FC8 basic module (MS425738-47) offers the possibility of combining eight optical channels in the 20 nm CWDM channel grid in the 1471 nm to 1611 nm wavelength range as a single useful signal.

Besides this standard version, a further 8 channel multiplexer with an integrated extension port is available (FC8X / MS425738E-47). A 16 channel CWDM multiplexer can be set up by cascading this multiplexer with the 8 channel model FC8A (MS425738A-27) for the lower CWDM wavelength range 1271 nm to 1431 nm.





2.2. CWDM Add/Drop Multiplexer AC1 / AC2

MICROSENS offers CWDM add/drop multiplexers (OADMs) to be in a position to branch off individual optical channels at intermediate points along a fiber optic link. These are used to drop or add one or two wavelength(s), while all other optical channels continue to be transmitted.

1XX1nm

1XX1nm

Link

West



Typ-071-R.vs

Link East

These passive 4 channel DWDM multiplexers bundle/split four optical channels on each module within the finely spaced DWDM frequency grid.

The filters are configured in the 100 GHz grid (4skip1) and are designed for the following channels:

- MS425744-21 => channel 21/22/23/24
- MS425744-26 => channel 26/27/28/29
- MS425744-31 => channel 31/32/33/34
- MS425744-36 => channel 36/37/38/39
- MS425744-41 => channel 41/42/43/44
- MS425744-46 => channel 46/47/48/49
- MS425744-51 => channel 51/52/53/54
- MS425744-56 => channel 56/57/58/59







2.4. DWDM Band Filters B4S / B4X / B8M / B8D

The design of larger DWDM infrastructures with up to 32 channels is possible by combining the following compact band filter modules:

The B4S (MS425710) band filter combines four bands (41 to 44, 46 to 49, 51 to 54, 56 to 59) each with four DWDM channels each in the 100 GHz grid (4skip1). A 16 channel multiplexer can thus be built up.

The B4X (MS425711) band filter also combines four bands (21 to 24, 26 to 29, 31 to 34, 36 to 39) each and provides an additional expansion port (41 to 59). This allows to build a cascaded 32 channel multiplexer – if desired in several steps.

Alternatively, the band filter modules B8M (MS425712-M) and B8D (MS425712-D) combine all available eight bands – each with four DWDM channels in the 100 GHz grid (4skip1) – to a 32 channel multiplexer. The B8M works as multiplexer and the B8D as de-multiplexer. This version also requires two slots, but in this case the attenuation in all eight bands is the same, as this 32 channel multiplexer isn't cascaded.

Instead of being mounted in an active chassis all filter modules can also be mounted in a cost-efficient 1U passive chassis for 19" installation (see chapter 1.1.3). The filter modules do not require a power supply.





2.5. Compact 1HU Filters

MICROSENS also provides a filter concept in a compact 1U case along with the plug-in filters requiring one slot each in the rack. These very light filter cases are mounted in an 19" rack and provide – apart from its flexibility – an excellent price-performance ratio.

2.5.1 8 Channel CWDM Filter (MS419860-33)



The 1U 8 channel MUX/DEMUX CWDM filter covers the wavlength range of 1470 – 1610 nm and comprises a multiplexer and a de-multiplexer in one case. The insertion loss of the 1U CWDM filter is appr. 4 dB (average), all interfaces are equipped with LC connectors. The device does not require a power supply.

2.5.2 18 Channel CWDM Filter (MS419863-33)



The 1U 18 channel MUX/DEMUX CWDM filter covers the complete CWDM wavelength range (1270 – 1610 nm) and is to be implemented in case more than just the "upper" 8 wavelengths are planned for in the network design. The insertion loss is appr. 6 dB (average), all interfaces are equipped with LC connectors. The device does not require a power supply.

2.5.3 8 Channel DWDM Filter (MS419871-cc)



The 1U 8 channel DWDM filter covers the lower range of the DWDM segment and provides a total of 8 subsequent ITU wavelengths (channels). The insertion loss of mux and demux is appr. 6 dB (average), all interfaces are equipped with LC connectors. The device does not require a power supply.

2.5.4 40 Channel DWDM Filter (MS419880)



The passive filter integrates 40 DWDM channel in an extremely compact 19" 1U case. It combines multiplexer and demultiplexer in a single device. An additional filter frame is not required. The compact 40 channel filter is recommended where a large scale final installation is planned for and the modularity of the MICROSENS filter cards is not needed. All interfaces are equipped with LC connectors. The device does not require a power supply.

3. Transponder Cards

3.1. 16G Dual Channel 2R Transponder CXG+ (MS425608M)

The CXG+ dual channel transponder module fits best for a low cost realisation using SFP and SFP+ Transceivers. Due to this functionality the module is universally applicable for Ethernet (1G/10G) and storage applications (1/2/4/8/10/16G Fibre Channel).

In its basic function the CXG+ is works as dual transponder and may be equipped with SFP or SFP+ transceivers for any wavelength (850 nm, 1310 nm, 1550 nm, CWDM or DWDM). This module provides two separate transmission channels, which can be used with any (different) data rate.

The CXG+ provides 2R functionality (Reamplification, Reshaping) and is ideally suited for point-to-point connections with a maximum distance up to 20 km. To cover longer distances the use of transceivers with CDR functionality (Retiming) on the application side is recommended. The retiming functionality of the 850 nm multimode or 1310 nm single mode SFP+ transceivers (in combination with the respective CWDM/DEWDM SFP+ at the other end of the link) distances of up to 80 km are possible. The use of SFP+ transceivers with CDR functionality is mandatory for the transmission of SDH signals.



3.2. 10G Single Channel Transponder TXG (MS425604M)

The TXG 10G transponder module converts local 10G multimode applications to a single mode or CWDM/DWDM wavelength. Alternatively, the TXG can also be used as a repeater for long distances. The transponder can be used for simple point-to-point applications or as a channel card in a high performance DWDM system.

The TXG module precisely regenerates all eight possible data rates associated with 10G. It is therefore universally applicable for both SDH, 10G Ethernet and 10G Fibre Channel. Forward error corrected data can also be transmitted and a special "cleaning mode" allows the use of several modules in a chain. This makes the TXG transponder ideally suited for regional ring networks.

A special feature is the integrated bit error rate tester (BERT). This allows a qualified evaluation of the quality of the data connection without having to connect expensive test equipment. As a result, installations are considerably simplified.

Through the use of pluggable XFP transceivers each wavelength (850 nm, 1310 nm, 1550 nm, CWDM or DWDM) can be used. When using tunable XFP transceivers the DWDM wavelength is set directly by the software in the module. This way a TXG transponder can cover all possible wavelengths in the system.



3.3. 10G Single Channel 2R Transponder CXG (MS425607M)

The CXG transponder module converts local 8.5G or 10G multimode applications to a single mode or CWDM/DWDM wavelength. Alternatively the CXG can also be used as a universal wavelength converter.

The CXG can be used for point-to-point applications or as a channel card in a high performance DWDM system. However, the use of a TXG transponder module is recommended for SDH applications or especially long 10G links.

Through the use of pluggable XFP transceivers any wavelength (850 nm, 1310 nm, 1550 nm, CWDM, DWDM or tunable) can be used, whereby spare part costs are reduced and flexibility is increased.

3.4. 4G Dual Channel SAN Transponder T4G (MS425602M)

The T4G module is the ideal transponder card for Gigabit Ethernet and Storage Area Network (SAN) applications (1/2/4G Fibre Channel), even over long distances.

The T4G can be equipped with any xWDM wavelengths or alternatively it may be used as a fast converter card. Due to the high quality 3R functionality, the T4G can be used as a repeater, whereby several fiber segments are cascaded to achieve long transmission distances. The T4G module provides two separate transmission channels, which can be used with any (different) data rate.

Through the use of SFP (Small Form Factor Pluggable) transceivers, any wavelength (850 nm, 1310 nm, 1550 nm, CWDM or DWDM) can be used.

3.5. 2.7G Dual Channel Crossbar Transponder X2G (MS425601M)

The X2G transponder module is ideal for use in virtually any application with data rates of 2 Mbps to 2.7 Gbps. In its basic function, the module works as a dual transponder and can also be configured easily e.g. to be a backup for business continuity applications.

The following functions can be selected by software configuration on the same module. The use of 3R signal regeneration and the extensive range of alarm functions are common to all modes of operation.

- The "Dual Converter Function" forms the basis of a point-to-point WDM system. This allows any wavelength conversions to be undertaken.
- "Crossover Mode" is an alternative dual channel mode. Day/night or active/test operation can also be switched on under software control as an alternative.





- "Backup Mode" for point-to-point applications. Data are automatically duplicated onto two paths, whereby the remote site selects the better or more functional source.
- "Ring Protection Mode" allows automatic alternative path switching per channel for individual wavelengths within an optical ring.
- The "Add/Drop Function" allows individual wavelengths to be added or dropped within a ring network.
- The "Repeater" or "Dual Repeater Function" allows the regeneration of individual channels in a ring in order to realise greater distances.
- "Drop & Continue" allows copying and simultaneous forwarding of regenerated data, e.g. a video signal can be duplicated to many antennas without loss of quality.
- "Switch Mode" allows software-controlled switching of a data source to one of three destinations (a/b/c switch). The three destinations can use different wavelengths or levels.



MICROSENS transponder application example

Through the use of pluggable SFP (Small Form Factor Pluggable) transceivers, each wavelength (850 nm, 1310 nm, 1550 nm, CWDM or DWDM) can be used to optimally adapt to the respective network topology (point-to-point, ring, star). The internal cross-connect, in conjunction with intelligent software, rounds off the solution with its flexibility. A high quality "Clock Recovery Function" also allows the use of many modules in series, even at the highest data rates. This enables WDM rings with a length of several hundred kilometres to be realised, for example.

This module mainly comes into use when constructing CWDM/DWDM topologies up to 2.7 Gbps. For applications beyond 2.7 Gbps the above described transponder modules with similar functional ranges are available.

3.6. Dual Gigabit Multiplexer M2G (MS425610M)

The M2G time division multiplexer module electronically combines two optical Gigabit data streams (Fibre Channel, FICON or Gigabit Ethernet) for transmission via a single 2.5 Gbps stream.

Through the use of pluggable SFP (Small Form Factor Pluggable) transceivers, each wavelength (850 nm, 1310 nm, 1550 nm, CWDM or DWDM) can be used to optimally adapt to the respective network topology – in many network designs the number of required wavelength is practically halved.

The M2G checks the protocol (not the content) of all incoming data streams for possible transmission errors. Therefore, a faulty fiber segment can quickly and efficiently be localized. This function is a major aid especially when diagnosing in larger ring networks. Furthermore a network operator can also quickly distinguish between internal network errors and external problems arising at his customers and can react actively.



Example: Point-to-Point 8x GigE over 4 wavelengths

With the internal "In-band-Management Function" of the M2G it is possible to transfer management data within the synchronisation frame of two interconnected M2G modules. This way all further MSP 1000 modules at these locations are fully controlled without the need for a separate and costly wavelength.

In addition the M2G module features an integrated protection switch logic and the respective logic for an autonomous fail-over to the backup path.



Example: 4 Gigabit applications over 2 wavelengths (with backup and repeater)



3.7. Dual Gigabit Multiplexer M2G (MS425610M)

When transmitting 40GE MICROSENS makes use of the transmission technology deployed for the QSFP+ transceivers (Quad Small From Factor Pluggable) which are intended for this application. These transceivers transmit the 40GE signal in the way of 4x 10GE, each using a CWDM wavelength (1270 nm, 1290 nm, 1310 nm und 1330 nm). This way MICROSENS can realise the 40GE transmission on the basis of a reliable and stable 10GE transmission. MICROSENS reduces the 40GE transmission to a 4x 10GE transmission and thus deploys the already described basic components. The only exception in this scenario is the 40GE filter (MS425734-27), which splits the incoming 40GE signal into 4x 10GE.

Just like for any other WDM service (1GE, 10GE, 2G FC, 4G FC, 8G FC, 16G FC) MICROSENS provides a local multimode or single mode based optical fiber connection also for the 40GE service.

Single mode Solution

40GBASE-LR4 40G QSFP+ LR4 Optical Transceiver

- > Supports a distance of up to 10 km via a single mode fiber
- The four CWDM lanes Mux/Demux channels are 1271 nm, 1291 nm, 1311 nm and 1331 nm.
- LC optical connector
- Operating temperature range:0~+70° C , power dissipation < 3.5 W</p>

Die Singlemode Lösung basiert auf dem 40G QSFP+ LR4 Transceiver und stellt sich wie folgt dar:



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Multimode Solution

40GBASE-SR4 40G QSFP+ SR4 Optical Transceiver

- Supports a distance of 100 m using OM3 multimode fiber or 150 m using OM4 multimode fiber
- > High reliability 4 channel 850 nm VCSEL laser
- MPO optical connector
- Operating temperature range:0~+70° C , power dissipation < 1.5 W</p>

Die Multimode Lösung basiert auf einem 40G CFP oder QSFP+ SR4 Transceiver und stellt sich wie folgt dar:



4. Security and Amplifier Portfolio

4.1. Optical Power Monitor OM1 (MS425631M)

The OM1 optical power monitor serves for level monitoring in optical networks. Typically the module is connected between a WDM filter (CWDM or DWDM link) and the fiber of the wide area network. There it continuously measures the attenuation budget respectively the optical power in the fiber. This data is displayed to the administrator via the management agent. The levels monitored are evaluated by the integrated OM1 software. An alarm is generated in case of a violation of the individually predefined threshold values.

There is a wide range of possible applications for the OM1 module. Using it as an "intrusion detector" offers users enhanced security, especially for transmission of sensitive data. The light energy necessary to intercept data reduces the light intensity on the fiber, what is detected by the OM1. An alarm is immediately triggered as outlined above.



Example: Use of OM1 with WDM System

The OM1 allows network operators an improved service, as a faulty transmission link can be detected from even the slightest deviations in attenuation before a total outage occurs.

Furthermore the OM1 can be used to assign fiber problems to certain line segments. For this purpose OM1 modules are strategically placed at each segment transition (for instance at the exchange point between carriers) and at each endpoint. If the level changes at some point in the middle, it is quickly determined which section is at fault.

Each OM1 offers two independent measurement channels (e.g. for receive and transmit level of a duplex cable or receive power level of two independent links). The OM1 cannot be used to read out optical data. Reset or software download will not interrupt data transmission through the module. An OM1 problem does not impair the optical data transmission.



4.2. Optical Spectrum Analyser OM2 (MS425632M)

The OM2 module provides a complete optical spectrum analyser for CWDM/DWDM systems on a compact plug-in module in Euro card format. The OM2 is used to measure and visualise all wavelengths within a CWDM/DWDM link and may generate network alarms depending on a number of wavelength related issues (optical power level, exact frequency and signal-to-noise ratio per wavelength).

The OM2 is used in combination with the OM3 optical tap coupler module (MS425633-1). The passive coupler is inserted into the data path and extracts 1% of the light which is provided on its monitor port for analysis by the OM2.





Functional principle: OM2 / OM3 within xWDM System

The OM2 updates all its measurements every second and is explicitly suuited for continuous operation. In practical applications the integration of OM3 modules at various places in the CWDM/DWDM sysstem is also possible. Individual OM3 modules can be deployed temporarily in the network as demanded.

Potential applications:

- Monitoring of optical power levels in CWDM/DWDM links
- Simultaneous measuring / monitoring / displaying of all possible wavelengths
- OSNR analysis (OSNR: Optical Signal to Noise Ratio)
- Continuous quality control of single wavelengths
- Documentation / verification of the transmission performance
- Troubleshooting support
- Level monitoring / adjustment in ROADM networks

4.3. EDFA Optical Amplifier EM3 (MS425643M)

The EM3 is an optical amplifier module which increases the optical power of a complete DWDM data stream without the need for de-multiplexing or conversion to the electrical domain. Thereby attenuation of DWDM filters and fiber cables can be compensated to increase the attainable distance.

The EM3 is inserted between the DWDM filter and the long distance fiber. The amplifier may be placed at the beginning (boost mode), the end (preamp mode) or both sides of the fiber – depending on the network requirements. The ideal installation depends on several parameters (e.g. number of channels and attenuation).



Example: Optical amplification in a DWDM system

The EM3 operates on the EDFA (Erbium Doped Fiber Amplifier) principle. Thanks to the integrated GFF (Gain Flattening Filter) all wavelengths in the fiber are amplified on the same level. Therefore the EM3 provides for cascading several amplifiers in line or for networks with a high DWDM channel count (up to 40).

The precise integrated optical power level test units of the EM3 record non-amplified and amplifed power levels and also the return channel, thereby enabling the continuous monitoring of the complete span during its operation. The threshold levels required for triggering an alarm can be set as demanded.



Each EM3 module is two slots wide and provides unidirectional amplification only. Typically a second amplifier is used at the far end of the optical fiber link.



4.4. Dispersion Compensation Module DC1 (MS425750-xx)

The DC1 dispersion compensation module is a passive element that is able to countervail the chromatic dispersion. Chromatic dispersion is a distortion of light pulses within fiber optic cables. This always occurs but increases with longer span lengths and higher data rates. The resulting signal is optically reshaped thereby easing the decoding of the signal by the receiver. The bit error rate is reduced drastically.

In contrast to the classic solution with dispersion compensation fiber spools, the additional delay with the modern DC1 module is practically nil, as it is based on the so called Fiber Bragg Grating (interference filters within the fiber). The module must be implemented for data rates from 10 Gbps and more, depending on the fiber typer and the deployed laser.

The DC1 module is offered in the following versions:

- **MS425750-40** => DC1 for appr. 40 km distance
- **MS425750-60** => DC1 for appr. 60 km distance
- **MS425750-80** => DC1 for appr. 80 km distance
- MS425750-100 => DC1 for appr. 100 km distance



Example: DC1 in a DWDM system

The very compact and absolutely passive DC1 module requires one slot in Euro card format and can be used in any DWDM systems in the C-band (51 channels in the 100 GHz grid) independent from the manufacturer. It works unidirectional with an optical loss of appr. 3 dB.



5. Transceivers

The comprehensive usage of modular optical transceivers in the MSP 1000 Platform provides the greatest possible flexibility in network configuration for the user. MICROSENS offers a broad spectrum of pluggable transceivers for all kinds of applications, such as SONET/SDH, Fast/Gigabit Ethernet and Fibre Channel.

5.1. SFP (Small Form-Factor Pluggable)

SFP transceivers fit into SFF slots, but may be exchanged quickly and easily (hot swappable). The digital diagnostic function of the SFPs provides reading out important management statistical and "live" data information such as serial number, type, temperature, transmission power and receiving level. Usually SFP transceivers are equipped with LC connection technology, but additionally so-called "Copper SFPs" with RJ-45 ports for Fast/Gigabit Ethernet are available.



Besides various multimode versions, MICROSENS offers a series of SFPs for single mode applications with adapted optical budgets. Special bidirectional WDM designs allow transmission of the sending and receiving channel on a single fiber optic (simplex).

Furthermore, specific SFPs transceivers for the transmission of E1/T1 or E3/T3 signals may be used in all MSP 1000 transponder modules with SFP slots.

CWDM SFPs are offered for 18 wavelengths and are available either for FE/GBE applications or as a multirate design for data rates from 100 Mbps to 4.25 Gbps for spans up to 200 km.

Higher channel numbers with data rates up to 4 Gbps can be realised using DWDM SFP transceivers. On account of the narrow channel grid, all channels can be amplified with optical amplifiers (EDFAs) therefore long distances can be overcome in wide-area networks.

5.2. SFP+ (Enhanced Small Form-Factor Pluggable)

SFP+ transceivers are an evolution of the favoured SFPs and are downwards compatible. Both have the same form factor but the SFP+ is designed for higher data rates (8G/10G/16G Fibre Channel or 10G Ethernet). The SFP+ transceivers offer the same digital diagnostic functions and are generally equipped with LC connection technology.

MICROSENS offers SFP+ transceivers for the optical transmission on multimode or single mode fiber for 10G Ethernet as well as for 8G/10G and even 16G Fibre Channel applications. As the initial problem to fit the Clock and Data Recovery (CDR) functionality in the constricted SFP+ package was partly solved by now, MICROSENS now also offers multimode and single mode SFP+ with CDR functionality for the application side. Hereby distances over 60 km can be realised with 2R transponder modules and high data rates.

Furthermore, there are SFP+ transceivers (without CDR) available for CWDM and DWDM applications. For DWDM applications MICROSENS also offers tunable variants. The xWDM SFP+ cover all data rates from 8 to 11 Gbps and are offered for ranges up to 70 km (CWDM), respectively 80 km (DWDM).

5.3. XFP (10 Gigabit Small Form-Factor Pluggable)

XFP transceivers are pluggable optical modules for transmitting 8G/10G signals. With the XFP standard digital diagnostic functions are generally available to the application, Therefore the network management can evaluate and display the current optical operating parameters.



MICROSENS offers XFP transceivers for optical transmission on multimode or single mode optical fiber. Depending on the version, distances of up to 120 km can be realised for single mode fiber optics.

With bidirectional transceivers (Bidi XFPs or WDM XFPs), the transmission (TX) and receiving channel (RX) of a service, such as 10 Gigabit Ethernet, are transmitted on a single fiber by means of different wavelengths (1270 and 1330 nm) in opposite directions. This technique is defined with the 10GBase-BX standard and is also known as 2 channel WDM. Versions are available for distances of up to 60 km.

Furthermore, transceivers are available for xWDM applications with wavelengths according to the ITU standard. The modularity of the optical connection achieves high flexibility for these applications. XFPs are available for both DWDM as well as CWDM applications. CWDM XFPs are suitable for 10G Ethernet and 10G Fibre Channel applications and are available with versions from 10 km to 80 km.

DWDM XFPs form the basis for the optical networks with higher channel numbers and greater distances. The DWDM XFP transceivers support all applications from 8G Fibre Channel, 10G Ethernet through to SONET/SDH. Adapted optical budgets are covered by the 40 km and 80 km versions. Special DWDM XFPs with optimised OSNR performance are deployed together with optical amplifiers (EDFAs).

Tunable XFPs – combined with the corresponding transponder module – allow the DWDM wavelength of the transceiver to be tuned in a predefined range in the 50 GHz grid. Therefor multirate versions for 10G Ethernet, SONET/SDH and 10G Fibre Channel with dispersion performance of 80 km and 200 km are available. Due to the universal usability of tunable XFPs, spares inventory may be simplified tremendously.

Management / Administration

The MICROSENS MSP 1000 Platform requires a management module (agent) in the form of a plug-in card to monitor the multiplex systems by means of SNMP or web based management. This agent is available in four different versions depending on the application (see chapter 1.3).

Locally, the agent is connected to the server via a 10/100Base-TX Ethernet port or a serial port (RS-232). The Ethernet port has the configuration of a terminal device and, using a standardised 1:1 patch cable, can be connected with a hub or switch socket. Automatic speed adjustment with the remote terminal is implemented with the integrated auto-negotiation protocol. Access to management function is always via the TCP/IP protocol.

The following applications are supported:

SNMP

The Simple Network Management Protocol is a standardised protocol to integrate device management in unified management platforms, such as HP Open View.

Access to the device-internal data structures is via the Management Information Base (MIB-II). This has to be integrated in the existing network management system. The MIB definition file can be loaded via a http download from the integrated MICROSENS Web Manager. The MIB file is in ASCII format.

http (web server)

The integrated management agent provides a web server based on the http protocol, which can be accessed with a standard internet browser (e.g. Microsoft Internet Explorer or Mozilla Firefox). Device statuses are displayed graphically (GUI).

TELNET

All device functions can also be configured and polled via a local series terminal. This terminal is available via the network port of the management system using the TELNET protocol.

Command Line Interface (CLI) – NM3 / NM3+ only

The switch, which is provided by the next generation of management modules, may additionally be configured and polled by the intuitively and easily operable Command Line Interface (CLI). Most important advantages are:

Features:

- Support of wildcards and named ports as variables
- Quick command entry due to auto-completion and command recall buffer
- Individual console prompt string
- Console inactivity timeout automatically logs out unattended terminal
- Logout in case of a dropped connection
- Supports color displays
- Online help for all parameters and commands
- Supports full scripting
- Offline configuration

NMP - Network Management Platform software

The Network Management Platform (NMP) is a universal tool used for configuring and monitoring all MICROSENS network components. A clear and concise graphical display and intelligent automation considerably unburdens the administrator in his daily tasks.

Besides the standard NMP, the NMP Professional Platform offers an extended range of functions, including an integrated topology manager. This allows network components to be positioned and connected together graphically on a map or a building plan. Alongside the general operating parameters, specific connecting points and their interconnections can also be monitored.

In the server version, the NMP is operated on a central server; client access is via a web interface. For increased requirements, the NMP server is operated redundantly in a network.

Features

- Graphic display of the device status and detailed status information at a glance
- Automated recognition of manageable MICROSENS components in the network
- Logical structuring of the network by defining device groups
- Simultaneous configuration of complete device groups or all devices
- Automated and time-controlled firmware updates for device groups
- Topology Manager (NMP Professional/Server)
- Server version (NMP Server) for parallel access of several administrators via web clients

Device Manager

The Device Manager is the core of NMP. Here all MICROSENS components are clearly arranged and graphically displayed and may be configured and monitored easily.

For doing so device lists are generated. These allow the grouping of network components based on a tree structure. The network components can be allocated to one or more groups depending on the organisational structure and therefore global settings can be assigned simultaneously. Device lists are sorted optionally on the basis of IP addresses, device names, device locations or firmware versions. Export is also possible (csv format).

🏂 MICROSENS Network Management Platform [admin: lesen/schreiben]													
Datei Bearbeiten Abfrage Daten Einfügen Gerätekonfiguration Ansicht Extras Anwendungs-Einstellungen Hilfe													
Öffnen Speichern Alle abf		🚯 Aktuelles abfra	gen G	erät hinzufügen	Gruppe hi	nzufügen I	MAC Erkennung	• 🗐 Inventarliste	Suche	Kan a set steer and set steer	Ginstellungen	[»] MIC	ROSENS
Device List	Stati	stik Geräteliste	Status	Topologie End	-To-End Pro	ovisioning							
0.100.90.111 : MICRC		[Liste komplett] 18 Geräte gefunden, 0 Alarme.											
10.100.90.112 : MICRC IP-Adresse Ger			Gerätena	ame	Grupp	e Geräteliste	Aufstellungsort	ngsort MAC-Adresse		bfrage	Letzte Antwort		<u>^</u>
10.100.90.114 : PLM 1	: PLM_' 🐻 10.100.90.111 MICI : FTTO. 🐻 10.100.90.112 MICI			ENS G6 Switch	Device	List			22.01.20	14 - 15:25:12	22.01.2014 - 12:55:10 22.01.2014 - 12:55:14		
10.100.90.121 : FTTO				ENS G6 Switch	Device	List			22.01.201	14 - 15:25:12			
Scan results	10.100.90.113 MIC			OSENS G6 Switch Devi		List			22.01.20	14 - 15:25:12	22.01.2014 - 12:55:13		-
iP range scan	🚳 Prange scan												
0 10.100.82/102 / RUDos 2102 /								ACK					
10.100.62.109 . R		- ^		1.016 (72.75)				- ·					
10.100.82.123 : S		Datum		ACK (Zeit)		Relevance	Seventy	Event so	ource	Source ID		Melaung	
10.100.82.125 : M	$\mathbf{\otimes}$	22.01.2014 15:25:	17	22.01.2014 15:2	25	POSITIVE	no error	Device		10.100.82.102	(Raum119-1)	Gerätestatus ok. Ab	frage beendet
10.100.82.126 : M	$\mathbf{\otimes}$	22.01.2014 15:25:	17	22.01.2014 15:2	25	POSITIVE	no error	Device		10.100.82.153	(Raum118-2)	Gerätestatus ok. Ab	frage beendet =
🐻 10.100.82.127 : M	$\mathbf{\otimes}$	22.01.2014 15:25:	17	22.01.2014 15:2	25	POSITIVE	no error	Device		10.100.82.113	(00F3EF)	Gerätestatus ok. Ab	frage beendet
🐻 10.100.82.153 : Ri	\odot	22.01.2014 15:25:	15	22.01.2014 15:2	25	POSITIVE	no error	Device		10.100.82.159	(Raum119-5)	Gerätestatus ok. Ab	frage beendet
10.100.82.155 : M	0	22.01.2014 15:25:	15	22.01.2014 15:2	25	POSITIVE	no error	Device		10.100.82.123	(Switch168)	Gerätestatus ok. Ab	frage beendet
🐻 10.100.82.156 : Ri	\odot	22.01.2014 15:25:	15	22.01.2014 15:2	25	POSITIVE	no error	Device		10.100.82.193	(Raum119-2)	Gerätestatus ok. Ab	frage beendet
🐻 10.100.82.159 : Ri	\bigcirc	22.01.2014 15:25:	14	22.01.2014 15:2	25	POSITIVE	no error	Device		10.100.82.109	(Raum102)	Gerätestatus ok. Ab	frage beendet 🔻
🐻 10.100.82.193 : Ri													+

The specific "MSP 1000 Platform IP Discovery" tool offers an automated discovery function to identify all active MSP 1000 modules within a broadcast domain. Afterwards the detected components may be added to the NMP device list.

ID IP-Adresse	MAC-Adresse	Übertragen zur Liste hinzufügen
1 10.100.90.52	00-20-4A-90-1A-16	Übertragen zur Liste hinzufügen
		Device List (4)
		DESKTOP (4)
		i MSP 1000 Platform
		10.100.90.52 :
	Schließen	🥥 Node: 504
		🧊 Unit: 1
		Slot 2 - NM2
		Slot 3 - TXC
		Slot 4 - X20
		Slot 5 - X20
		Slot 6 - T40
		Slot 7 - EM

Statistics, status and log data and – where applicable – network topologies will be displayed in clear and concise windows with tab structure.



The appropriate access authorisation assumed, configurations may be managed comfortably, e.g. software updates are quite simple.

Software manager: Node: 504 Unit 1 / Slot 2							
- Running Cod	le in unit at Node:	Firmware update					
Core:	22.10.2012	16/1	ArmCore V3.71	Select firmware file			
Application:	22.10.2012	14/1	ArmNMS3/4 V3.71	Info:			
		SW Date: SW Type:					
Primary Cod	e	Build:					
Core:	22.10.2012	16/1	ArmCore V3.71	Module:			
Application:	22.10.2012	14/1 ArmNMS3/4 V3.71		Target: 💿 Primary 🔘 Fallback			
			Remove Primary Code	Start firmware update			
			Copy to Fallback section 🕀				
- Fallback Cod	e						
Core:	22.10.2012	16/1	ArmCore V3.71				
Application:	22.10.2012	14/1	ArmNMS3/4 V3.71				
			Remove Fallback Code				
	Refre	Close					

Topology Manager

The NMP software provides an additional tool for graphic display and monitoring of devices – the Topology Manager. Here network components are positioned graphically on a map or building plan and are connected together. Alongside the general operating parameters, specific connecting points and their interconnections can also be depicted and monitored. The maps are generated on the basis of the components shown in the device list.

The maps can be depicted on several levels. Simple relations country / campus / city / building / room can be depicted. The NMP software displays an additional information window where two connected devices are supported by the NMP software and their management data are available. This allows a detailed connection of these two devices (port-to-port connection).

All map elements (connection anchor, device icons and group icons) can be moved freely with drag & drop. The connections between the devices and between the connections are easy to edit at any time.

The Topology Manager uses loaded device data for monitoring the defined link status. If one or both devices are not available or the connection is interrupted for some of the devices connected, the connection icon flashes (faulty). A connection can be deleted or its colour, size and style changed. Anchors can be added or removed freely, which allows optimal adaptation of the connection to the map depiction; connection parameters can also be described.

Special map elements – external connectors – can also be added. These elements are displayed in grey with a special icon. External connections represent devices from third-party manufacturers that are not supported by the NMP software.



NMP server

The Network Management Platform (NMP) server version is database-oriented and allows a client-independent web access to all relevant network information, as well as secure integration of external user groups.

Administrators gain more flexibility in accessing relevant network information and configuration files. The server provides secure web based access and allows administrators to undertake configurations via the web front end, also via smartphones or tablet PCs.

Installation of client software is no longer necessary. This also simplifies integration of external user groups, such as IT service providers, with the aid of dedicated access rights. A detailed rights structure now allows the respective rights to be assigned to certain device groups or individual network components.

Redundant design, parallel access and automatic documentation

The NMP server allows parallel access of unlimited number of administrators with automatic recognition of simultaneous configuration access to individual devices. Die Number of users is controlled by a license.

The server version stores the device groups, device configurations and topology information, including change history, in an SQL database. Administrators therefore receive full documentation of all changes and configuration steps performed with precise designation of the respective user at the same time.

Reduction of recovery times

Practical functions like master configuration with automatic transmission of the settings on device group level or time-controlled firmware updates ease the administrator's daily work and therefore ensure shorter recovery times. In the event of a device replacement, the NMP software automatically recognises the new identical device and can automatically restore configurations and firmware settings.

Moreover, the NMP software offers end-to-end provisioning for the optical transport platform. Individual services have to be configured at their respective start and end points only. All systems in-between configure themselves automatically with the aid of the NMP server.

The NMP server is available for operation on Windows and Linux operating systems [R1]and in various licensing levels and with an annual update service.

Specifications

NMP Server (MS200164-n, license for n years, 5 clients included)

- Standard PC system
- Operating system > Microsoft Windows XP, Linux
- Minimum requirements:
 - o 2048 MB RAM
 - 1GB free space on the hard disk
- MySQL database for device and client information
- Database-oriented storage of the switch configuration
- History function of client actions in database
- Operation of 2 parallel NMP servers in one network (redundancy)
- MySQL database replication service
- Client authentication via RADIUS
- Supports access via HTTP or HTTPS with configurable TCP port

NMP client (MS200166-Cn, additional access licenses for n clients)

- Microsoft Windows or Linux operating system
- Web browsers: Microsoft Windows IE 7, or Mozilla Firefox 3.5.x (or higher), Google Chrome
- JavaScript must be activated in the web browser
- Screen resolution 1280 x 1024 or higher

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